## **University Program Overview Ignition, Friction and Emissions Research**

Tom J. George, DOE/NETL Project Manager Debbie Haught, DOE/EE Program Sponsor

**Funding** 

Office of Power Technologies/Office of Energy Efficiency and Renewable Energy





## Vision

Execute university research resulting in breakthrough and innovative technology that will be to the benefit of U.S. industry and do so in a manner respectful of a university's mission:

"Learning at the highest level"



## **Objective of First Solicitation**

# Natural gas reciprocating engine research to:

- Aid Program Goals (efficiency, emissions, durability and cost).
- Engage Industry (ex., they defined the ignition and friction reduction topics).



#### **First Solicitation Selections**

- 1. Univ of Texas, "Reduced Engine Friction"
- 2. Univ of Texas, "Railplug Ignition..."
- 3. Col State Univ, "Studies of Ignition Processes..."
- 4. Mass Insti. of Technology, "Ignition Improvement..."
- 5. MIT, "Engine Friction Modeling"
- 6. Purdue, "Surface Modification to Cut Losses"
- 7. Univ of S. Calif, Corona Discharge Ignition"

Four ignition and three friction selections.



## **Budget for First Seven Selections...**

	DOE & Share \$1000	DOE Funds \$1000	DOE 2001 \$1000	DOE 2002 \$1000	DOE 2003 \$1000	DOE 2004 \$1000
Ignition Improvement	2,378	1,846	100	643	749	352
Parasitic Loss	2,240	1,774	100	608	685	377
TOTAL	4,618	3,620	200	1,251	1,434	729
AVERAGE AWARD SIZE/Year				179	205	104

#### ...20%+ Cost Share Additional Funds



## **Status/Schedule of 2nd (Emissions) Solicitation...**

- 8 Proposals received.
- 2-3 to be selected.
- Selection by end of May.
- Award by end of Summer.

... Industry Participating in Selection Process



## **University of Texas: Low Friction**



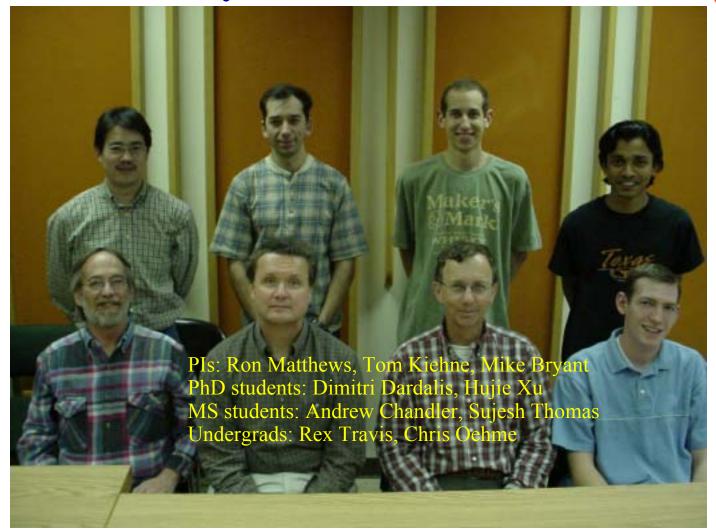
- Reduce piston assembly friction.
- Design-fabricate a single cylinder rotating liner.
- Test via motoring, unloaded firing, loaded firing.
- Develop large bore rotating cylinder model.





\$755,600 Total, \$557,700 DOE, 36 months

### **University of Texas Friction Team**





## **University of Texas: Railplug Ignition**



- Improve performance & reduce maintenance.
- Develop design tool
- Optimize for large bore
- Improve existing model & extend to railplug.

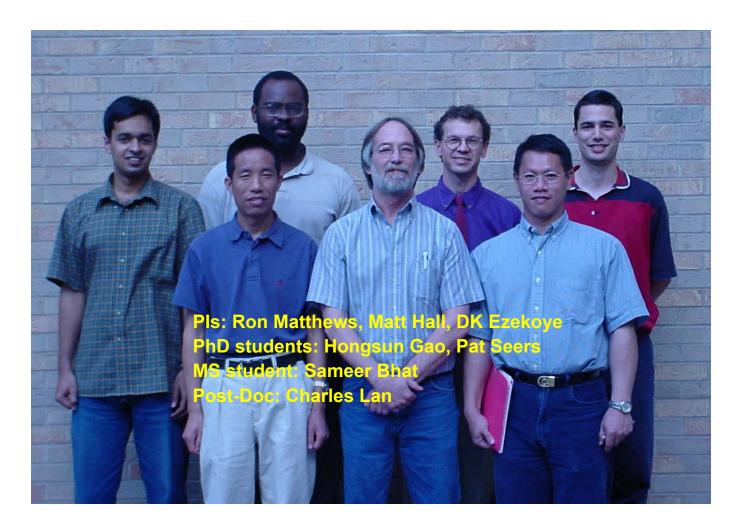




\$670,500 Total, \$491,500 DOE, 36 months

## **University of Texas: Ignition Team**



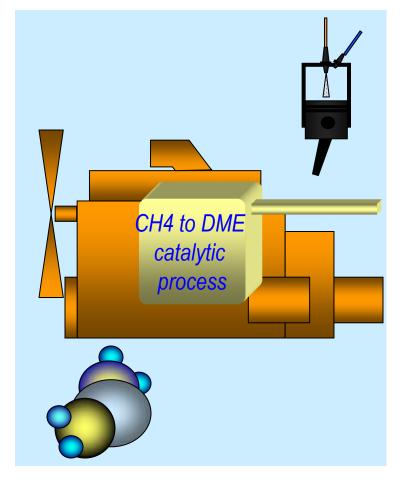






## Michigan Technology University (Ignition Improvement)

- GOAL: ignition superior to pilot injection & low emissions.
- Develop scalable onboard DME reactor
- Investigate operational characteristics of minute quantities of DME.





\$373,900 Total, \$295,600 DOE, 24 months



## Michigan Technological University (DME Ignition Improvement Team)



Dr. Duane L. Abata Dr. Jason Keith Dr. Michael Mullins Dr. Kirk Schulz Dr. Simon Chen Mr. Lee Oberto



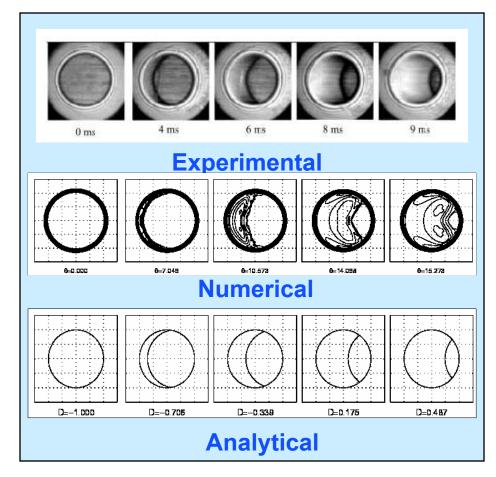


#### Purdue University



#### Tribology Laboratory

- Investigate surface pattering
- Develop CFD models (mixed & boundary)
- Design bench scale
  IC test rig.
- Measure friction of commercial rings and cylinders.





\$459,400 Total, \$575,300 DOE, 36 months

## **Purdue University Friction Team**







PI: Farshid Sadeghi\*

Nathan Bolander, Ph.D. Student

Brian Steenwyk, M.S. Student

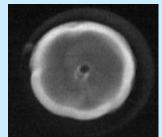
\*There are seven other students (3 Ph.D. and 4 M.S.) involved in lubrication, friction and wear studies in METL.

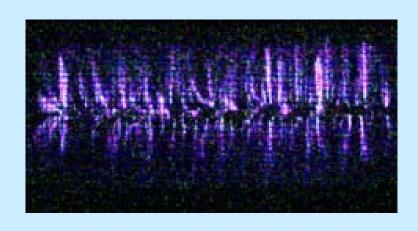


## **University of Southern California (USC) (Corona Discharge Ignition)**

- Characterize a lean burn ignition based upon corona discharge ignition.
- Characterize waterinjected ignition environment.
- Characterize low turbulence ignition environment.

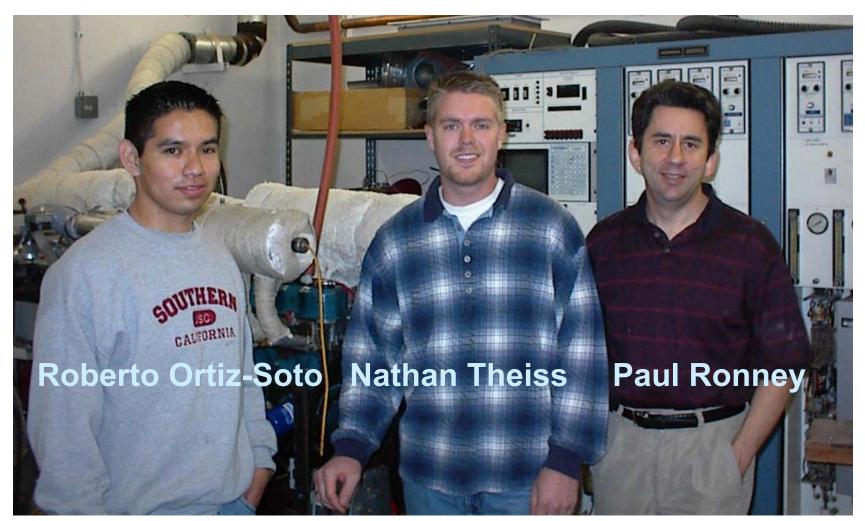








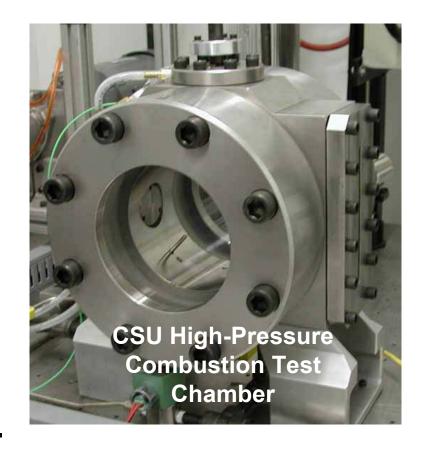
## **USC Ignition Team**





#### **Colorado State University** (Fundamental Laser Ignition Studies)

- Use existing ND: YAG laser ignition source.
- Conduct fundamental studies.
- Demo on up-rated production engine (high- BMEP Waukesha VGF)
- Goal is to prove performance and life.





\$736,800 Total, \$500,000 DOE, 24 months

#### **Colorado State University Ignition Team**





## Massachusetts Institute of Technology (Low Engine Friction)

- Use computer modeling to find pathways to minimize friction.
- Validate models with Waukesha VGF engine .
- Determine fundamental design parameters and performance relationships.
- CSU a subcontractor





\$910,000 Total, \$728,100 DOE, 24 months

## **MIT Low Engine Friction Team**

